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CENDL-2 update 95

The Chinese Evaluated Nuclear Data Library
for Neutron Reaction Data

by the Chinese Nuclear Data Center

1991/1995

Summary documentation

by Liang Qichang, H.D. Lemmel (ed.)

Abstract: This document summarizes the contents of CENDL-2.1, the 1991 version of the evaluated neutron reaction data library by the Chinese Nuclear Data Center which was updated and supplemented in 1995. The present update contains an increase from 54 to 67 materials, and revised and supplementary data for almost all materials. The entire library or retrievals of selected materials are available on CD-ROM or magnetic tape from the IAEA Nuclear Data Section upon request, cost free. The library is also available online within NDIS, the IAEA Nuclear Data Information System.

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Online: TELNET or FTP: iaeand.iaea.org
username: IAEANDS for interactive Nuclear Data Information System
usernames: ANONYMOUS for FTP file transfer;
FENDL2 for FTP file transfer of FENDL-2.0;
RIPL for FTP file transfer of RIPL;
NDSONL for FTP access to files sent to NDIS "open" area.
Web: http://www-nds.iaea.org

Note:

The IAEA-NDS-reports should not be considered as formal publications. When a nuclear data library is sent out by the IAEA Nuclear Data Section, it will be accompanied by an IAEA-NDS-report which should give the data user all necessary documentation on contents, format and origin of the data library.

IAEA-NDS-reports are updated whenever there is additional information of relevance to the users of the data library.

For citations care should be taken that credit is given to the author of the data library and/or to the data center which issued the data library. The editor of the IAEA-NDS-report is usually not the author of the data library.

Neither the originator of the data libraries nor the IAEA assume any liability for their correctness or for any damages resulting from their use.

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Citation guideline:

The present data library should be cited as follows:

> Chinese Nuclear Data Centre, "A brief description of the second version of the Chinese Evaluated Nuclear Data Library CENDL-2", Communication of Nuclear Data Progress No. 6 [same as report INDC(CPR)-25] Beijing, China, 1991. Data library CENDL-2.1, including 1995 updates, received on tape [or retrieved online] from the IAEA Nuclear Data Section (date). Summary documentation by Liang Qichang, H.D. Lemmel (ed.), report IAEA-NDS-61 Rev. 3, 1996.

CENDL-2

The Chinese Evaluated Nuclear Data Library
for Neutron Reaction Data

version 2.1 of 1995

by Liang Qichang, Zhou Delin, Liu Tingjin
Cai Dunjiu, Zhang Jingshang, Yuan Hanrong

Chinese Nuclear Data Center
Institute of Atomic Energy
P.O. Box 275(41), Beijing, P.R. China

CENDL-2 was received at the IAEA Nuclear Data Section in 1991, with supplements in 1992, 1993, and 1995.

It contains evaluated neutron reaction data for 67 elements or isotopes from 1-H-1 to 98-Cf-249. See the table of contents on the following pages.

The entire library has about 500 000 records.

A CENDL-2 summary report by the authors is included in the present document. Additional reference:

- Liu Tingjin, Liang Qichang, Su Zongdi:
  CENDL-2, Chinese Evaluated Nuclear Data Library Version 2, Int. Conf. on Nuclear Data for Science and Technology, 13-17 May 1991 Jülich, Germany, Proc. (1992) p. 804-810.

A more extensive description of the evaluations was published in "Communication of Nuclear Data Progress No. 6 (1991)" [same as reports CNIC-596; CNDC-8; INDC(CPR)-25], and "Communication of Nuclear Data Progress No. 6 Suppl. (1992)" [same as reports CNIC-690; CNDC-10; INDC(CPR)-28].

The 1995 update presents revisions for almost all materials, and an increase from 54 to 67 materials, and from 270 000 to 500 000 records. New evaluations were added for 17-Cl, 24-Cr isotopes, 26-Fe isotopes, 29-Cu isotopes, 71-Lu, 80-Hg, 81-Tl. The following materials were replaced by new evaluations, mostly resulting from Chinese-Japanese collaborations: 13-Al-27. 20-Ca, 24-Cr, 25-Mn-55, 26-Fe, 29-Cu, 41-Nb-93, 47-Ag. For many materials the data were modified for the secondary neutron energy spectra, and γ production data were added. In addition, various small improvements were made.

Release condition:

The data library CENDL-2 has been released freely with the understanding

- that reprints of publications in which CENDL-2 data have been used;
- that results obtained when testing and inter-comparing benchmark data with CENDL-2 data; and
- that comments on data accuracy or deficiencies encountered in the data files

should be sent to: Dr. Liang Qichang
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P.O. Box 275(41)
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with copy to: Dr. H.D. Lemmel
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P.O. Box 100
A-1400 Vienna, Austria

Format:

The data library CENDL-2 was produced partly in ENDF-5 format which is documented in detail in the report IAEA-NDS-75 Rev. 1, partly in ENDF-6 format which is documented in detail in the report IAEA-NDS-76, Rev. 4, which is essentially a reprint of the report BNL-NCS-44945 of July 1990 (ENDF-102), updated by Rev. 10/91 of the same report. For the 1993 and 1995 revisions all files have been converted to ENDF-6 format.

For use of this data library a set of computer codes is required. Both, data library and computer codes are available on CD-ROM or magnetic tapes from the IAEA Nuclear Data Section free of charge.

Available computer codes:

The 2000 ENDF Pre-Processing Codes, "Pre-Pro 2000", by D.E. Cullen
See document IAEA-NDS-39 Rev. 10

ENDF Utility Codes from NNDC, version 6.11.
See document IAEA-NDS-29 Rev. 8.

INDXENDF: A PC code by R. Paviotti Corcuera et al., which indexes ENDF-6 formatted data files that are on the hard disk.
See document IAEA-NDS-131

Not available from IAEA:

NJOY: A system for processing ENDF formatted data files. For a summary see document IAEA-NDS-119. This code package must be requested from the

Radiation Shielding Information Centre (RSICC)
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, TN 37831
U.S.A.

CENDL-2.1 (1995)

Format: ENDF-6

Summary of Contents

In general, the files contain all neutron cross-section and scattering data in the energy range from 0 to 20 MeV, including resonance parameters. When the files contain additional data such as double differential cross-sections, γ production data, or covariances, this is indicated in the "Comments" column.

MAT	Rev.	Nucl.	First Author, date	Comments	Documentation
2011	Rev. 1 94	1-H-1	Cai Dunjiu 1978		
2012	Rev. 1 94	1-H-2	Zhuang Youxiang 1990	Double diff., cross-sections, covariances, γ production data (figure for double diff (n,2n) see 91Jülich p. 808)	CNDC-8 pp. 7-13
2013	Rev. 1 94	1-H-3	Zhuang Youxiang 1991	Double diff. cross-sections, covariances	CNDC-8 pp. 14-21
2021	Rev. 1 94	2-He-3	Zhao Zhixiang 1991	Double diff. cross-sections, covariances	CNDC-8 p. 22
2022	Rev.1 94	2-He-4	Dai Nengxiong 1978		
2031	Rev. 1 94	3-Li-6	Zhou Delin 1978		
2032		3-Li-7	Yu Baosheng 1991	γ production data	
2040		4-Be-9	Zhang Zhenqian 1978	γ production data	
2051	Rev. 1 94	5-B-10	Chen Qiankun 1991 Qi Huiquan 1982	γ production data	CNDC-8 p. 24
2052		5-B-11	Qi Huiquan 1982/90		CNDC-8 p. 25
2071		7-N-14	Hu Baohai 1983		
2081	Rev. 1 94	8-O-16	Liu Tingjin 1992	γ production data, covariances, neutron energy spectrum modified.	CNDC-10 pp. 3-16

MAT	Rev.	Nucl.	First Author, date	Comments	Documentation
2091		9-F-19	Zhao Zhixiang 1990	Double diff. cross-sections, γ production data, covariances. This evaluation was included in ENDF/B-6.	CNDC-8 pp. 26-29
2110	Rev. 1 94	11-Na-23	Xu Zhizheng 1983 Wu Zhihua 1991	94: modified energy spectra of secondary neutrons	CNDC-10 pp. 17-23
2120	Rev. 1 94	12-Mg	Tang Guoyou 1983/1991	94: modified energy spectra of secondary neutrons	CNDC-8 pp. 30-35
2131	new 94	13-Al-27	Yu Baosheng, S. Chiba, Y. Harima 1991/1994	new evaluation, replacing the previous evaluation by Liu Jicai 1988; double diff. cross-sections, γ production data.	
2140	Rev. 1 94	14-Si	Shi Zhaomin 1983 Tang Guoyou 1991	94: modified energy spectra of secondary neutrons	CNDC-8 pp. 42-46
2150	Rev. 1 94	15-P-31	Zhou Yongyi 1986	94: modified energy spectra of secondary neutrons	CNDC-10 pp. 24-28
2160	Rev. 1 94	16-S	Shi Yi 1986	94: modified total cross-section and energy spectra of secondary neutrons	CNDC-8 pp. 47-52
2170	new 94	17-Cl	Zhao Jingwu 1994	double diff. cross-sections, γ production data	
2190	Rev. 1 94	19-K	Zhou Yongyi 1988	94: modified total cross-section and energy spectra of secondary neutrons	CNDC-8 pp. 53-63
2200	Rev. 1 95	20-Ca	Tang Gouyou 1986/95	95: Re-evaluation; double diff. cross-sections, γ production data	CNDC-10 pp. 28-36
2220	Rev. 1 94	22-Ti	Yao Lishan 1986	94: modified total cross-section and energy spectra of secondary neutrons, added: γ production data	CNDC-8 pp. 64-76
2230	Rev. 1 94	23-V-51	Zhou Yiming 1990	94: modified energy spectra of secondary neutrons	CNDC-8 pp. 77-93

MAT	Rev.	Nucl.	First Author, date	Comments	Documentation
2240	new 95	24-Cr	Yu Baosheng, S. Chiba, T. Asami, 1991	new evaluation, replacing the previous evaluation by Ma Gonggui; double diff. cross-sections, γ production data	
2241	new 95	24-Cr-50	Yu Baosheng, S. Chiba, T. Asami, 1991	double diff. cross-sections	
2242	new 95	24-Cr-52	Yu Baosheng, S. Chiba, T. Asami, 1991	double diff. cross-sections	
2243	new 95	24-Cr-53	Yu Baosheng, S. Chiba, T. Asami, 1991	double diff. cross-sections	
2244	new 95	24-Cr-54	Yu Baosheng, S. Chiba, T. Asami, 1991	double diff. cross-sections	
2251	new 95	25-Mn-55	Yu Baosheng, K. Shiba, K. Shibata, 1991	new evaluation, replacing the previous evaluation by Liu Yunchang 1986; double diff. cross-sections, γ production data, covariances	
2260	new 95	26-Fe	Yu Baosheng, S. Chiba, S. Iijima, 1991	new evaluation, replacing the previous evaluation by Liu Tingjin 1987; double diff. cross-sections, γ production data	
2261	new 95	26-Fe-54	Yu Baosheng, S. Chiba, S. Iijima, 1991	double diff. cross-sections, γ production data	
2262	new 95	26-Fe-56	Zhao Zhixiang, et al., 1995	double diff. cross-sections, γ production data	
2263	new 95	26-Fe-57	Yu Baosheng, S. Iijima, S. Chiba, 1991	double diff. cross-sections, γ production data	
2264	new 95	26-Fe-58	Yu Baosheng, S. Iijima, S. Chiba, 1991	double diff. cross-sections, γ production data	
2271		27-Co-59	Qi Huiquan 1986		CNDC-10 pp. 41-52

MAT	Rev.	Nucl.	First Author, date	Comments	Documentation
2280	Rev. 1 94	28-Ni	Ma Gonggui 1990	94: modified total cross-sections and secondary neutron energy spectra; for Ni(n,α) difference between CENDL-2 and ENDF/B-6 (see 91Jülich page 808)	CNDC-8 pp. 127-141
2290	new 95	29-Cu	Yu Baosheng, S. Chiba, N. Yamamoto	new evaluation replacing the previous evaluation by Zhou Yiming 1990; double diff. cross-sections, γ production data	
2291	new 95	29-Cu-63	Yu Baosheng, S. Chiba, N. Yamamoto	double diff. cross-sections, γ production data	
2292	new 95	29-Cu-65	Yu Baosheng, S. Chiba, N. Yamamoto	double diff. cross-sections, γ production data	
2300	Rev. 1 94	30-Zn	Jing Jirong 1983 Liang Qichang 1993	Data of CENDL-1 (1983) supplemented in 1993 with data from BROND-2. 94: γ production data	
2400	Rev. 1 94	40-Zr	Zhou Yiming 1990	94: modified total cross-sections and secondary neutron energy spectra; added: γ production data	CNDC-8 pp. 158-172
2411	new 95	41-Nb-93	Yu Baosheng, S. Chiba, M. Kawai, 1991	new evaluation replacing the previous evaluation by Ma Gonggui 1990; double diff. cross-section, γ production data	
2420	Rev. 1 94	42-Mo	Liu Shengkang 1983	94: γ production data added	

MAT	Rev.	Nucl.	First Author, date	Comments	Documentation
2470	Rev. 1 94	47-Ag	Liu Tingjin, T. Nakagawa, K. Shibata, 1987	γ production data Note: this evaluation results from the two isotopic evaluations. The previous version of CENDL included the following isotopic evaluations, but had, for 47-Ag, the independent evaluation by Wang Yansen 1989, which was now dropped.	
2471	Rev. 1 94	47-Ag-108	Liu Tinjin 1987	γ production data joint Chinese/Japanese evaluation, same data in CENDL-2 and JENDL-3	CNDC-8 pp. 194-210
2472	Rev. 1 94	47-Ag-109	Liu Tinjin 1987		
2480	Rev. 1 94	48-Cd	Sun Yaode 1989	94: secondary neutron energy spectra modified, γ production data added	CNDC-10 pp. 53-59
2490	Rev. 1 94	49-In	Wu Zhihua 1989	94: secondary neutron energy spectra modified, γ production data added	CNDC-10 pp. 60-66
2500	Rev. 1 94	50-Sn	Yao Lishan 1989	94: γ production data added	CNDC-8 pp. 210-219
2510	Rev. 1 94	51-Sb	Yao Lishan 1985	94: modified: total cross-sections and secondary neutron energy spectra; added γ production data	CNDC-8 pp. 220-229
2710	new 95	71-Lu	Yao Lishan 1993	new evaluation for reaction cross-sections; data for scattering and secondary neutrons taken from ENDF/B-6	
2720	Rev. 1 94	72-Hf	Wu Zhihua 1983/1991	94: modified total cross-sections and secondary neutron energy spectra; added: γ production data	CNDC-10 pp. 66-71
2730	Rev. 1 94	73-Ta-181	Yao Lishan 1989	94: γ production data added. For (n,2n) and (n,3n) difference between CENDL-2 and ENDF/B-6 (see 91Jülich p. 809)	CNDC-8 pp. 230-241

MAT	Rev.	Nucl.	First Author, date	Comments	Documentation
2740	Rev. 1 94	74-W	Ma Gonggui 1986	94: secondary neutron energy spectra modified; γ production data added	CNDC-8 pp. 242-249
2790	Rev. 1 94	79-Au-197	Yuan Hanrong 1991	94: secondary neutron energy spectra modified; γ production data added	CNDC-8 pp. 249-267
2800	new 95	80-Hg	Ma Gonggui 1993	New evaluation; double diff. cross-sections	
2810	new 95	81-Tl	Zhou Yiming 1993	New evaluation; double diff. cross-sections	
2820	Rev. 1 94	82-Pb	Zhou Yiming 1986	94: modified total cross-sections and secondary neutron energy spectra; added γ production data	
2921		92-U-235	Yu Baosheng 1992	ENDF/B-6 evaluation updated for (n,2n), (n,3n), and delayed neutrons.	
2922	Rev. 1 94	92-U-238	Tang Guoyou 1990	94: double diff. cross-sections and covariances added. For U-238(n,n') difference between CENDL-2 and ENDF/B-6 (see 91Jülich p. 810)	CNDC-8 pp. 279-287 and CNDC-12 p. 53
2931	Rev. 1 94	93-Np-237	Tang Guoyou 1990	94: modified secondary neutron energy spectra	CNDC-8 pp. 287-297
2941	Rev. 1 94	94-Pu-239	Liang Qichang 1979/1990	94: modified secondary neutron energy spectra; for Pu-239(n,f) and (n,2n) difference between CENDL-2 and ENDF/B-6 (see 91Jülich p. 810)	CNDC-10 pp. 72-84
2942	Rev. 1 94	94-Pu-240	Cai Dunjiu 1992	includes γ production data and covariances. 94: minor changes	CNDC-10 pp. 84-97
2951	Rev. 1 92	95-Am-241	Zhou Delin 1988	γ production data and covariances. This evaluation is included in ENDF/B-6.	CNDC-10 pp. 97-113
2971		97-Bk-249	Zhou Delin 1986	This evaluation is included in ENDF/B-6.	CNDC-10 pp. 114-117

MAT	Rev.	Nucl.	First Author, date	Comments	Documentation
2981		98-Cf-249	Zhou Delin 1989	This evaluation is included in ENDF/B-6.	CNDC-10 pp. 118-123